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(12) UK Patent Application (19) GB (11) 2 299 037 (13) A

(43) Date of A Publication 25.09.1996

(21) Application No 9605008.3

(22) Date of Filing 08.03.1996

(30) Priority Data
(31) 19510283 (32) 22.03.1995 (33) DE

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(51) INT CL^6
B21C 37/15 , B21D 53/06

(52) UK CL (Edition O)
B3A A122K A158

(56) Documents Cited
GB 2141362 A EP 0429166 A US 5186250 A

(58) Field of Search
UK CL (Edition O) B3A
INT CL^6 B21C 37/00 , B21D 53/00 , F28F 1/00
On Line Databases:WPI,EDOC,JAPIO

(54) Flat tube for a soldered heat exchanger and a method for its production

(57) A flat tube (10) for a soldered heat exchanger and a method for production thereof are disclosed. The flat tube (10) has a welded longitudinal edge and beads (2) abut one another forming at least one partition extending longitudinally and dividing the internal space into chambers. The beads (2) are welded in their contact positions (8).

Fig. 2

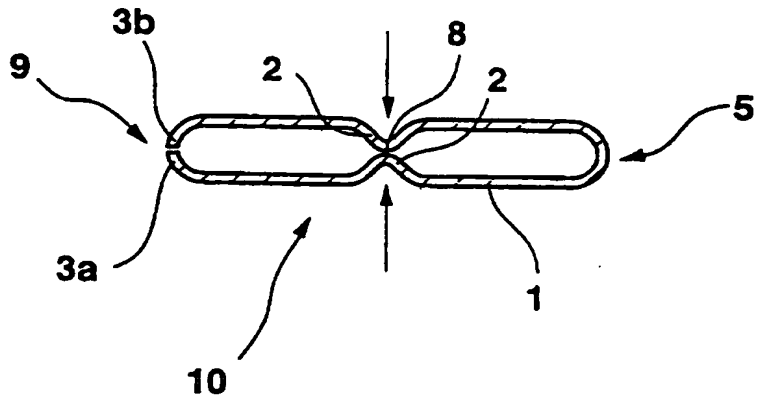

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Fig. 1

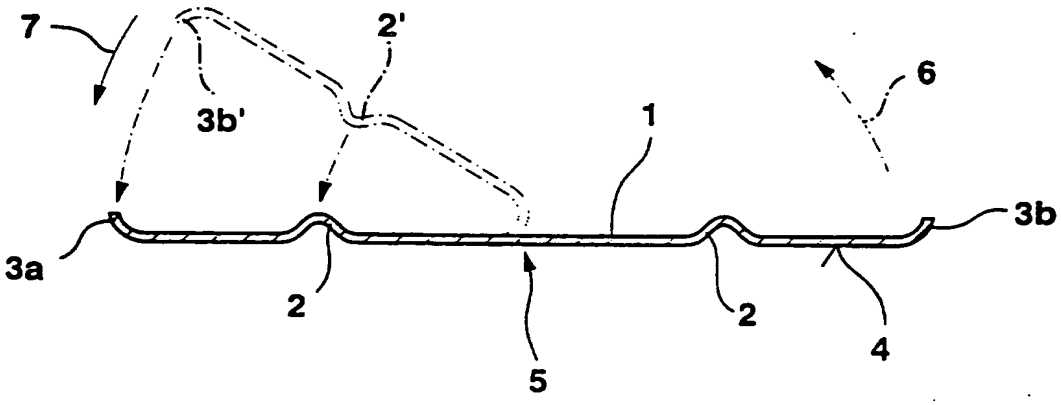


Fig. 2

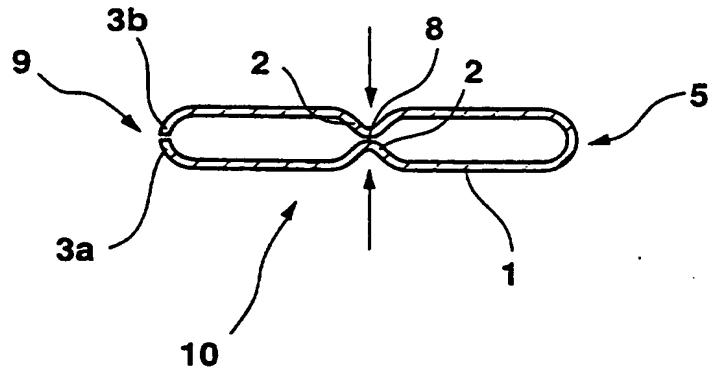
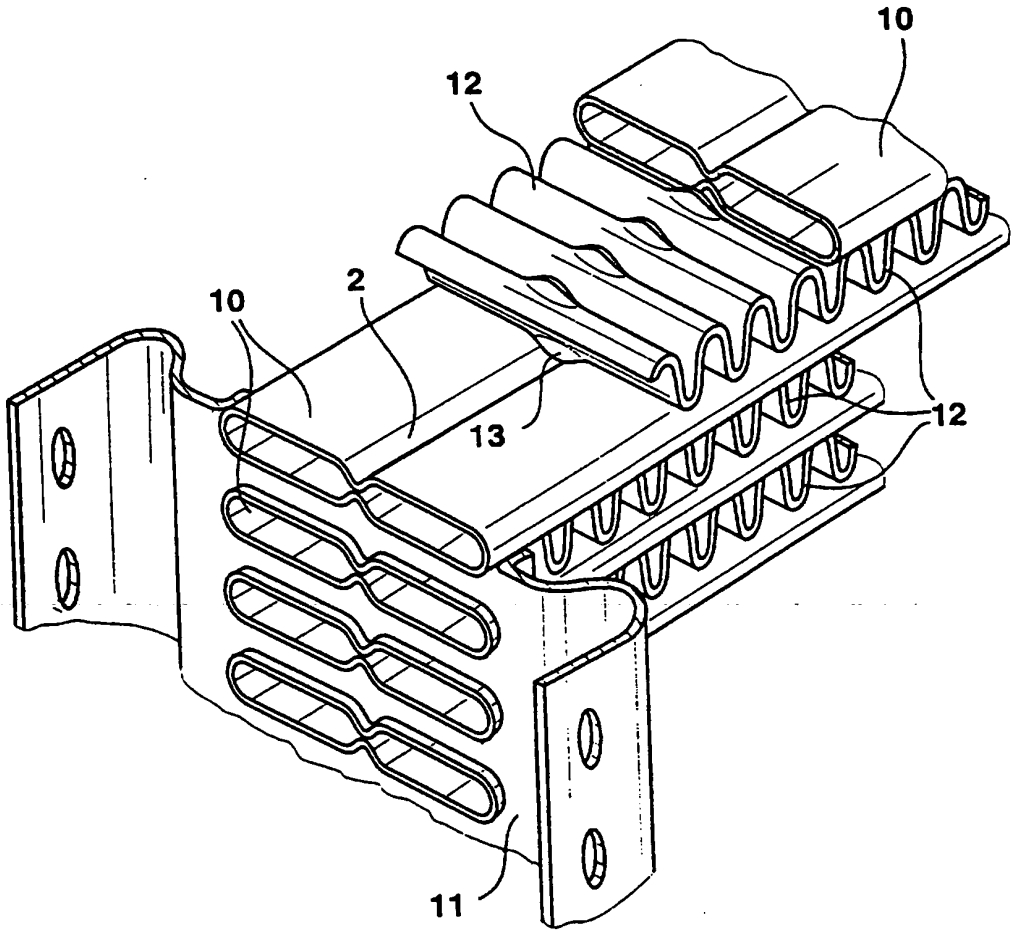


Fig. 3



Flat tube for a soldered heat exchanger and a method for its production

The invention relates to a flat tube for a soldered heat exchanger, particularly of aluminium, with a welded longitudinal edge and with beads which are stamped inwardly on the longitudinal sides and abut one another forming at least one partition extending longitudinally and dividing the internal space into chambers.

Flat tubes for the production of soldered heat exchangers are known (DE 40 26 988 A1) and are composed of a metal strip solder-plated on at least one side and provided with beads extending parallel to its longitudinal sides, the strip then being bent to the tube shape and welded on its abutting longitudinal edges. In order to form the heat exchangers, flat tubes of this type are then inserted with both ends in tube bases and are thus oriented with their longitudinal sides parallel to one another and are provided with corrugated ribbed strips disposed between them and serving to increase the transfer of heat. Heat exchangers made up in this manner are generally soldered in a complete soldering process in which an uncontrolled accumulation of too much solder may occur on the insides of the tubes. If an

application of fluxing agent is used, then it is difficult to introduce the fluxing agent into the tube uniformly and to remove the moisture from the tube again before soldering. Both circumstances may lead to the tube being either insufficiently leakproof or insufficiently firm in the region of the beads, which may lead to undesired damage owing to the internal pressure in operation. An undesired accumulation of solder may lead to disturbance of the flow which is also undesirable.

The object of the invention is to design a flat tube of the type mentioned at the beginning in a manner such that the disadvantages described do not arise so that, with the use of the flat tubes, heat exchangers can also be connected by soldering processes which require an application of fluxing agent.

This object is achieved, according to the invention, with a flat tube of the type mentioned at the beginning, by virtue of the fact that the beads are welded in their contact positions. This measure makes soldering inside the tube unnecessary and an application of fluxing agent with subsequent drying can take place relatively easily in all other connection positions of the flat tube and thus on the tube base or to the

corrugated ribbed strips, for example, by the Nocolok method, without difficulties arising with the accessibility of the parts to be supplied with fluxing agent or with the drying. Flat tubes according to the invention can therefore be used for the production of Nocolok-soldered heat exchangers.

In a development of the invention, a method may be provided for producing the flat tubes in which, first of all, longitudinal beads are stamped outwardly from a metal strip solder-plated at least on the side which will subsequently be on the outside, the beads abutting one another inside the tube after the bending of the metal strip to tube shape and the welding of the free longitudinal edges, and is characterized in that these abutting beads are welded longitudinally. Moreover, the welding may take place partially with a pulsed laser beam which advantageously follows the tube welding machine for producing the longitudinal seam.

It is, however, also possible to provide for continuous welding by means of inductive hot pressure welding for the welding of the beads, which takes place either before the welding of the longitudinal bead or afterwards.

The invention is explained below with reference to an embodiment shown in the drawings, in which:

Figure 1 shows a metal strip which serves as the starting material for the production of a flat tube and is bent to the tube shape;

Figure 2 shows the metal strip of Figure 1 in tube shape with welded longitudinal beads before the welding of the longitudinal seam; and

Figure 3 is a partial view of a heat exchanger produced with the use of flat tubes according to Figure 2.

Figure 1 shows that, in order to produce the novel flat tube, a metal strip (1), particularly of aluminium is provided and, first of all, is equipped with two longitudinal beads (2) extending parallel to one another and stamped towards the same side, and with longitudinal edges (3a and 3b) bent upwards towards the same side as the beads. This metal strip (1) is provided, on its flat underside (4) which does not have projecting beads (2), with an AlSi plating so that soldering to other parts can be carried out subsequently according to the Nocolok process.

As shown by a broken line, the metal strip (1) is then bent upwardly in the direction of the arrow (6) about its centre-line (5) so that its longitudinal edge (3b') faces the longitudinal edge (3a). The bead (2) disposed on the side with the longitudinal edge (3b) then reaches the position (2') and, with further bending in the direction of the arrow (7), abuts the bead (2) as shown in Figure 2. The metal strip (1) already bent to tube shape according to Figure 2 is then welded on the line (8) on which the beads (2) abut one another, for example, by inductive hot pressure welding. The longitudinal seam (9) between the longitudinal edges (3a and 3b) is then formed with the aid of a tube welding machine.

Alternatively, the welding on the line (8) may be formed by a pulsed laser beam which, for example, is made to follow the tube welding machine for forming the weld seam (9). Naturally, it would also be possible to form the weld seam formed by inductive hot pressure welding between the beads (2) after the formation of the weld seam (9).

The flat tube (10) shown in Figure 2 is now assembled with a plurality of others according to Figure 3 in a manner such that respective longitudinal sides of the flat tubes (10) are

disposed parallel to one another. This is achieved by virtue of the fact that the ends of the flat tubes (10) are inserted in tube bases (11) which are then closed in known manner by a collector. A corrugated strip (12) is inserted between each pair of adjacent flat tubes (10) and, in the embodiment shown by way of example, is provided, in the region of the summits of its corrugations, with respective stamped tabs (13) which are disposed in the inwardly-pressed portions of the beads (2) of the flat tubes to locate the corrugated strip (12). The flat tubes (10) formed according to the invention and used for this so-called coffering process are distinguished by the fact that they are particularly stable and rigid for assembly and are connected to the corrugated strips (12) with a positive fit.

When the coffering process has been completed in the manner described, the heat exchanger thus assembled can be soldered, for example, in the Nocolok process. This requires the application of fluxing agent. It can easily be seen from Figure 3, however, that this fluxing agent can easily be applied, for example, by spraying of the spaces between the flat pipes (10) and can reach the gaps to be soldered between flat tubes (10) and tube

bases (11), on the one hand, and between the summits of the corrugations of the corrugated strips (12) and the longitudinal sides of the flat tubes (10), on the other hand. The fluxing agent thus applied is then dried so that leakproof soldering can subsequently take place by the transfer of the coffered heat exchanger according to Figure 3 into a soldering furnace.

As can easily be seen, with this soldering process, the admission of solder or fluxing agent into the interiors of the flat tubes (10), which gives rise to undesired accumulation of solder therein or leads to the disadvantage that the flux is not uniformly distributed in the tube and cannot be dried thoroughly, is not necessary. The novel heat exchanger according to Figure 3 is therefore a soldered heat exchanger but is produced with the use of exclusively welded flat tubes (10).

CLAIMS

1. Flat tube of metal, for a soldered heat exchanger, with a welded longitudinal edge and with beads which are stamped inwardly on the longitudinal sides and abut one another forming at least one partition extending longitudinally and dividing the internal space into chambers, characterized in that the beads are welded in their contact positions.

2. Method of producing flat tubes according to Claim 1, in which, first of all, longitudinal beads are stamped outwardly from a metal strip solder-plated at least on the side which will subsequently be on the outside, the beads abutting one another inside the tube after the bending of the metal strip to tube shape and the welding of the free longitudinal edges, characterized in that the beads are welded longitudinally.

3. Method according to Claim 2, characterized by partial welding of the bead with a pulsed laser beam.

4. Method according to Claim 3, characterized in that the laser beam follows the

tube welding machine for forming the longitudinal seam.

5. Method according to Claim 2, characterized by a continuous weld with the aid of an inductive hot pressure welding method.

6. Method according to Claim 5, characterized in that the welding of the beads takes place before the welding of the longitudinal seam or vice versa.

7. Use of flat tubes according to Claim 1 for heat exchangers of which the flat tubes arranged parallel to one another are soldered in tube bases and to corrugated ribs disposed between them in the Nocolok process.

8. Flat tube according to Claim 1, characterised in that the metal is aluminium.

Amendments to the claims have been filed as follows

1. Flat tube of metal for a soldered heat exchanger, the tube being solder-plated on the outside only, having a welded longitudinal edge and having concave beads stamped inwardly on the longitudinal sides, the beads abutting one another to form at least one partition extending longitudinally and dividing the internal space into chambers, wherein the beads are welded in their contact positions.

2. Method of producing flat tubes according to Claim 1, in which longitudinal beads are stamped from one side in a metal strip, the strip is bent into a tube shape with beads abutting one another, the free longitudinal edges of the tube shape are welded, and the abutting beads are welded longitudinally.

3. Method according to Claim 2, characterized by partial welding of the bead with a pulsed laser beam.

4. Method according to Claim 3, characterized in that the laser beam follows the _____

tube welding machine for forming the longitudinal seam.

5. Method according to Claim 2, characterized by a continuous weld with the aid of an inductive hot pressure welding method.

6. Method according to Claim 5, characterized in that the welding of the beads takes place before the welding of the longitudinal seam or vice versa.

7. Use of flat tubes according to Claim 1 for heat exchangers of which the flat tubes arranged parallel to one another are soldered in tube bases and to corrugated ribs disposed between them in the Nocolok process.

8. Flat tube according to Claim 1, characterised in that the metal is aluminium.

The Patent Office

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Application No: GB 9605008.3 **Examiner:** A.R.Martin
Claims searched: All claims **Date of search:** 16 May 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B3A

Int Cl (Ed.6): B21C 37/00,B21D 53/00, F28F 1/00

Other: On line databases :WPI,EDOC,JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2141362 A	MTU see Fig 1	Claims 1 and 2 at least
X	US 5186250 A	Showa see Figs 2a-2d	"
A	EP 0429166 A	Wallis see Fig 7	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.